measured, and an average level of attenuation of 1.9 dB.[38] Applying these propagation effects to the signal from a Motient terrestrial handset, it is clear that with these frequently low levels of attenuation, *Inmarsat would not be afforded the requisite level of interference protection from Motient's terrestrial system.* As Inmarsat showed in its Comments, 3-4 dB of attenuation still leaves the Motient signals with far too high a power level, and far too great a potential for interference into Inmarsat. Not even Motient has suggested that Inmarsat should be expected to suffer a significant level of interference over 50% of the time. And Inmarsat's calculated average attenuation of 1.9 dB is a far cry from the 22.4 dB value that Motient asserts as an "average" in urban areas.

C. Motient's Proposed Uplink Interference Management Plan Is Not Feasible

Recognizing that its proposed terrestrial component could cause interference, Motient has proposed to self manage the interference.[39] The proposal, however, is flawed for four main reasons: (i) it assumes an interference threshold that is not applicable to terrestrial-based interference, and not acceptable in any event; (ii) Motient will not be able to accurately measure at its spacecraft the terrestrial-based interference received at Inmarsat's satellites; (iii) if Motient could measure the level of interference, there is no practical way for it to cease providing service to its terrestrial customers; and (iv) it is not reasonable to allow Inmarsat's competitor, Motient, to decide when and whether its system is interfering with Inmarsat's network.

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38 *See id.* at Section 3.3.

39 *See* Motient Comments at 17 and Technical Appendix.

1. <u>ITU Rules Do Not Require Inmarsat To Accept Some Baseline Level of Terrestrial Interference Into Its MSS System</u>

At the outset, Motient's interference management plan is fundamentally flawed because it is based on an inapposite ITU parameter. Motient has based its proposed terrestrial service on the premise that its terrestrial service may generate part of the 6% Δ T/T interference level that is the ITU baseline for when a satellite system needs to be coordinated with an adjacent satellite system. For the reasons Inmarsat has explained in its Comments, under the ITU Radio Regulations, there simply is no such baseline that applies for the interference generated by a terrestrial service, particularly one that does not conform to the ITU Table and does not even have a secondary status.[40] Motient attempts to use an inapplicable standard to give an air of legitimacy to the unacceptable interference that its proposed terrestrial service would cause to Inmarsat's satellite network.

2. <u>Motient's Proposed Uplink Monitoring Mechanism Does Not Work</u>

Motient's proposed monitoring mechanism cannot accurately measure the interference that would be received by the Inmarsat spacecraft. Motient suggests that it can use its satellites to monitor the level of aggregate interference caused by its terrestrial communications services. As discussed more fully in the Supplemental Technical Annex, however, Motient cannot accurately measure solely the interference generated by the terrestrial component of its system. Moreover, any measuring at Motient's satellites cannot be extrapolated to estimate the interference that will be experienced by Inmarsat's satellites.

40 Boeing also incorrectly uses this threshold interference value in its interference analysis. *See* Boeing Comments, Exhibit A at 2. Discounting this factor from Boeing's analysis demonstrates that the potential interference from a terrestrial-based service would have an even greater effect on MSS operators.

Because Motient's MSS satellite operates at a different orbital location that the spacecraft in the Inmarsat system, the level of terrestrial interference that each spacecraft actually receives from Motient's terrestrial terminals will vary. It is likely that there will be times when Inmarsat's satellites will receive more interference than that received at Motient's satellite. As shown in the Supplemental Technical Annex, there are many cases under which a terrestrial signal could be blocked at a given elevation and azimuth angle, and therefore would be attenuated in the direction of the Motient spacecraft, but that same signal would continue at its full strength at other elevation and azimuth angles, in the direction of the Inmarsat spacecraft.[41]

Moreover, based on Motient's own description of its proposed system, the accuracy of interference measurements in areas outside Motient's receive beam will be highly limited.[42] In order to adequately measure the interference to Inmarsat's satellites, interfering signals into the Inmarsat satellite antenna sidelobes would also need to be measured and aggregated. Motient simply cannot conduct that measurement at its own spacecraft.

Finally, to the extent that Motient could use its satellite receivers to measure interference from its proposed terrestrial components, these measurements would not be accurate. The signal from Motient's satellite terminals, which the Motient spacecraft is intended to receive, will dominate the satellite receiver and severely limit its ability to measure terrestrial-based interference.[43]

3. <u>There Is No Realistic Way For Motient To Cease Causing Interference</u>

Even if Motient were able to accurately measure the interference caused to Inmarsat's satellite network, neither Motient nor any other party has suggested a realistic and

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41 *See* Supplemental Technical Annex at Sections 1.1 & 3.4.

42 *See* Supplemental Technical Annex at Section 1.2.

practical means to cease the interfering transmissions. In its comments, Motient urges the Commission to authorize the building and testing of terrestrial facilities "at Motient's own risk."[44] Other operators have suggested that terrestrial components be allowed to operate on a non-interference basis.[45] Neither proposal is appropriate for two reasons: (i) Inmarsat has demonstrated that there will be an interference problem to which there is no feasible solution, and (ii) it is not realistic to expect that a broadly-deployed, consumer-oriented service would be able to cease or curtail its operations once it commenced.

If Motient were allowed to develop a terrestrial component as part of its next generation, L-Band satellite system, Motient would have to spend hundreds of millions of dollars, if not billions, to do so. It defies logic to believe that Motient would be willing to voluntarily cease terrestrial use of the L-Band upon a showing of interference to Inmarsat's system. First, having spent hundreds of millions of dollars on new satellites and dual-mode mobile handsets, Motient's own financial incentives, and the pressures from its stockholders and debt holders, to continue the development of the service under any circumstances would become overwhelming. This is particularly true in Motient's case, because Motient has identified the proposed terrestrial component of its next generation system as "key" to overcoming the technical limitations that make it difficult for Motient to sustain itself as "a viable satellite only mobile communications business."[46]

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43 *See* Supplemental Technical Annex at Section 1.3.

44 *See* Motient Comments at 30.

45 *See* Globalstar Comments at 10; *see also* Comments of Iridium Satellite LLC at 3, IB Docket No. 01-185, ET Docket No. 95-18 (filed Oct. 22, 2001) ("Iridium Comments") (advocating the designation of spectrum in the 2 GHz, Big LEO and L-Band for terrestrial use on secondary basis).

46 *Application* at 12.

Moreover, once Motient starts to provide communication services to its customers, no one reasonably can expect that Motient will simply tell those customers that their service area or level of access will be curtailed, or, even worse, that their service will be cut off altogether, because the aggregate interference from the Motient system has exceeded a certain level. In short, consumer demand will drive the need to continue service and Motient would have significant incentives to continue and expand the service regardless of interference issues.

4. Motient Cannot Be Responsible For Monitoring Its Own Interference

As discussed above, the success of Motient's proposed terrestrial service is of the utmost importance to Motient. Inmarsat cannot be placed in a position where Motient, its competitor, is responsible for monitoring and addressing the interference problems that Motient itself creates. As discussed in Inmarsat's Comments, Inmarsat would suffer interference from the proposed terrestrial services, but Inmarsat would be unable to measure the interference caused by the terrestrial component, as opposed to the interference caused by the satellite component, of the Motient system. Motient will have no incentive to develop a means to reliably measure, at its satellite, the signals from its terrestrial components. Moreover, it would exacerbate the situation if the Commission not only allowed ancillary terrestrial uses, but also allowed terrestrial uses to be operated by non-MSS based mobile communications providers.[47]

D. Uplink Interference From Terrestrial Service In The Big LEO Band

Some commenters promote the use of an ancillary terrestrial component to MSS systems in the Big LEO MSS frequency bands. This would involve potentially large numbers of terrestrial mobile transmitters operating in the 1610-1626.5 MHz band, which is immediately adjacent to the Inmarsat MSS uplink band (1626.5 MHz and above). For the same reasons as those described in Inmarsat's Comments, the aggregate effect of the out-of-band emissions of these terrestrial mobile transmitters could cause harmful interference into the Inmarsat uplinks that are operating in the U.S.[48] Thus, the Commission should decline to adopt its ATC proposal in the Big LEO band as well.

E. It Is Premature To Develop Technical Standards For ATCs In The L-Band

As Boeing and other have discussed in their Comments, serious interference problems are presented by the proposed terrestrial use of MSS spectrum, including the L-Band. Inmarsat has demonstrated the scope of this serious problem in its Comments. The problem here flows from a proposed use of the L-Band that is fundamentally inconsistent with the allocation of this band under the ITU Table, the United States' commitments under the Mexico City MOU, and the systems that have been coordinated to date under that MOU. This is not a problem that can be solved by the technical rules proposed by Motient and Constellation.[49] A brief review of the proposed rules shows why those proposals are woefully inadequate to solve the interference problem.

1. Motient's Terrestrial Equipment Would Interfere With Inmarsat's MESs

Inmarsat has already shown how Motient's proposed terrestrial equipment[50] would cause harmful interference to Inmarsat's mobile terminals. Inmarsat's analysis of this interference was based on an assumption that the Motient base stations would meet out-of-band emission requirements similar to those in 47 C.F.R. § 24.238. Therefore, contrary to Motient's

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47 *See, e.g.,* Comments of AT&T Wireless Services, Inc., IB Docket No. 01-185, ET Docket No. 95-18 (filed Oct. 22, 2001).

48 *See* Supplemental Technical Annex at Section 4; *see also* Inmarsat Comments, Technical Annex at Section 3.2.

49 *See* Motient Comments at 23-25; *see also* Constellation Comments at Appendix.

50 *See* Motient Comments at 26-27.

assertion, the out-of-band emission standards for broadband PCS equipment, as given in 47 C.F.R. § 24.238, are clearly insufficient to solve this interference problem, and Motient's rule proposal is therefore unacceptable.

Motient also proposes to apply the PCS rules regarding tower heights, power limits and coordination procedures to ancillary terrestrial systems.[51] Using assumptions about the potential Motient base stations that are consistent with these PCS rules, Inmarsat showed in its Comments that harmful interference would occur based on overload of the Inmarsat receivers from the adjacent-channel transmissions of the Motient base stations.[52] Therefore the PCS rules in 47 C.F.R. §§ 24.232 & 24.237 would do nothing to prevent this harmful interference from occurring, and Motient's rule proposal is therefore unacceptable.

2. Proposed Filtering Would Waste Scarce Spectrum

With regard to out-of-band emissions, Motient asserts in its Comments that existing out-of-band limits in 47 C.F.R. § 24.238 are appropriate to protect adjacent frequency bands.[53] As shown in the Inmarsat Comments,[54] those existing limits are not sufficient. Notably, Motient does recognize that the adjacent Radio Navigation Satellite Service ("RNSS") band (used by GPS) needs to be protected.[55] To accomplish this, Motient proposes a filter characteristic that shows a one MHz guard band. While the filter does protect the RNSS band, it

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[51] *See* 47 C.F.R. §§ 24.232 & 24.237. These rules limit base stations to an EIRP of 1640 watts (32 dBW) with an antenna height of 300 meters and allow higher antenna heights at lower EIRP levels.

[52] Inmarsat assumed that Motient would operate 25 carriers per base station at a carrier EIRP of 19.1 dBW, i.e. the total EIRP of the base station was assumed to be 33 dBW. *See* Inmarsat Comments, Technical Annex at Section 3.3.1.

[53] *See* Motient Comments at 26.

[54] *See* Inmarsat Comments, Technical Annex at Section 3.4.

leaves the rest of the 1525-1559 MHz band unprotected. Similarly, MDS/ITFS licensees have explained the out-of-band interference into their systems that would result from terrestrial uses of the L-Band, and WCA advocates the use of guardbands to protect against such interference.[56]

Guardbands used to facilitate terrestrial services, however, would be spectrally inefficient and reduce the L-Band frequencies usable for true MSS services in an environment where there is already a severe spectrum shortage. Allowing supposedly ancillary terrestrial systems to operate in such an inefficient manner is not consistent with the Mexico City MOU, particularly when there are MSS operators that are able and willing to put the entire L-Band to use for MSS services.

F. Non-Integrated Terrestrial Operations

As great as the interference problems are that exist with Motient's proposed terrestrial use of the L-Band spectrum, the problems that would be caused by a non-integrated terrestrial operation would be significantly greater. All the interference issues discussed above and in Inmarsat's Comments apply equally to a terrestrial communications provider that does not also operate a satellite network. In addition, a terrestrial operator would not have any incentive to reduce interference into affected satellite networks, and as Motient points out, annual coordination negotiations under the Mexico City MOU are not open to terrestrial operators. More fundamentally, that MOU does not permit terrestrial uses, so there is no basis for the Commission to authorize terrestrial uses of the L-Band.

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[55] *See* Motient Comments at Exhibit E (showing the characteristics of a filter to be placed at the output of a base station transmitter to protect this band above 1559 MHz).

[56] *See* WCA Comments at 4.

III. TERRESTRIAL USES OF THE L-BAND CANNOT PRACTICALLY BE LIMITED TO AN ANCILLARY SERVICE

As Motient and others recognized, the urban markets provide a significant marketing opportunity for a terrestrial-based component to an MSS system.[57] Motient has discussed its proposed next generation system as supporting the deployment of millions of terminals, in contrast with the 200,000 terminals that is currently is licensed to operate.[58] Similarly, Globalstar recognizes, in the case of its Big LEO system, that "ATC authority necessarily will increase substantially the number of Globalstar subscribers."[59] As discussed in Inmarsat's Comments, if the Commission were to allow an ATC to Motient's L-Band satellite network, the scope of that terrestrial component would soon overshadow the satellite service offerings.[60]

While many commenters have noted that an "ancillary" restriction would be an important limitation that could prevent MSS operators from becoming primarily a terrestrial-based mobile communications provider,[61] they fail to recognize that any attempt to limit a terrestrial component to an ancillary role is, as a practical matter, unenforceable. Once in service, it would be difficult to prevent such an ancillary service from outgrowing its restrictions. It is unlikely that any regulator would demand that a company stop providing service to its

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57 *See Application* at 13; *see also* Stratos Comments at 9.

58 *See Application* at 13.

59 Globalstar Comments at 19.

60 *See* Inmarsat Comments at 26-27.

61 *See, e.g.,* Comments of the Cellular Telecommunications & Internet Association at 3-7, IB Docket No. 01-185, ET Docket No. 95-18 (filed Oct. 22, 2001) ("CTIA Comments"); Joint Comments of the Association for Maximum Service Television, Inc. and the National Association of Broadcasters at 14-15, ET Docket No. 00-258, ET Docket No. 95-18, IB Docket No. 99-81, IB Docket No. 01-185 (filed October 22, 2001); Comtech Comments at 5.

customers based on the fact that its business has grown too much and the scope of its service offerings has expanded too far. It is more likely, as is the case of the proliferation of DARS transmitters, that the growth will be allowed to continue beyond what the Commission originally intended.[62] The only effective way to prevent the terrestrial aspect of Motient's proposed service from becoming the primary aspect of its L-Band operations is to maintain the current prohibition on providing terrestrial services using L-Band spectrum.

Even under the Commission's definition of "ancillary," the proposed Motient terrestrial implementation would lead to levels of interference that would be so high as to reduce the MSS spectrum available to the MSS community as a whole for *satellite* service. Such an impact on the international MSS community, brought about by a terrestrial use within the U.S. that contravenes the ITU Table of Frequency Allocations, would violate the principles embedded in the ITU's Radio Regulations, and undermine the international allocation of the L-Band for MSS services. Those international allocations provide the very basis for the deployment of MSS systems, such as Inmarsat's, that provide vital safety and business services. For these reasons, the Commission should decline to authorize terrestrial services in the L-Band.

IV. MOTIENT'S PROPOSED TERRESTRIAL USE WOULD INCREASE MOTIENT'S SPECTRUM NEEDS

Contrary to Motient's assertion, the provision of ancillary terrestrial services in the L-Band would increase the spectrum scarcity problems in that band. Inmarsat explained in its Comments why the Motient proposal would reduce the traffic-carrying capacity of the Motient satellite. Based on information presented in Motient's Comments,[63] there is yet another

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62 *See* Comments of the National Association of Broadcasters at 3-4, IB Docket No. 95-91 (filed August 21, 2001) (discussing history and growth of DARS).

63 *See* Motient Comments, Technical Annex at 3-4.

reason why the implementation of such a service would result in greater spectrum demand by Motient. As discussed in the Supplemental Technical Annex, the use of spectrum to provide terrestrial service in a given geographic area would limit Motient's ability to re-use that spectrum for satellite service not only within the satellite spot beam that covers that geographic area, but also in any of the adjacent spot beams.[64] Because those affected beams utilize every megahertz of Motient's L-Band spectrum assignment, there is no way that a terrestrial component could operate without directly taking spectrum away from Motient's satellite service. In other words, there is no "free lunch."

Inmarsat agrees with Motient that demand for any spectrum based on terrestrial uses should not be taken into consideration in the annual coordination process under the Mexico City MOU.[65] Since the addition of a terrestrial component would mean that Motient would no longer be able to carry as much satellite traffic in the L-Band spectrum that is currently coordinated for its satellite system, the only way that Motient could support a terrestrial component would be by using unused spectrum it has coordinated for its satellite use. However, if Motient does not need the spectrum that is currently coordinated for its satellite system's use, then under the MOU coordination process, the excess spectrum should be made available to another MSS provider who needs it. Allowing Motient to maintain the excess spectrum in order to roll out an ATC would shift the burden of the terrestrial component onto Inmarsat and the other existing MSS operators in the L-Band by denying them access to spectrum that is needed to expand their satellite-based systems.

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64 *See* Supplemental Technical Annex at Section 5.

65 *See* Motient Comments at 26.

V. THE L-BAND SHOULD REMAIN DESIGNATED SOLELY FOR SATELLITE USAGE

As discussed above and in Inmarsat's Comments, the proposed use of terrestrial components in the L-Band presents unique interference, legal and safety problems. Motient has urged the Commission to authorize Motient to provide a terrestrial-based service as part of its next generation of MSS service so that Motient will be able to serve urban and suburban areas. Motient's request, however, can best be addressed through existing options, such as dual-band handsets, without opening the L-Band to terrestrial uses and creating the significant issues presented here.

A. Dual-Band Handsets Are A Viable Solution

Multi-band phones are widely available and currently in use all over the world. Tri-band GSM phones are commonly used to allow users to access various mobile communications networks operating on different frequencies. Despite protests to the contrary, multi-band phones are small, lightweight and reasonably priced[66] and create an effective means of providing mobile communications through an integration of MSS satellite services and terrestrial networks.[67] The solution for L-Band operators who need to enhance their service offerings in suburban and urban areas is simple – a dual-band phone that accesses a cellular or PCS network when MSS service is not available.[68]

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66 Tri-band phones weighing approximately 3.5 ounces can be purchased for approximately $150 retail. *See* Exhibit A (List of Ericsson and Motorola tri-band phones).

67 *See* Globalstar Comments at 14.

68 Many commenters agree that dual-band phones offer a viable method of offering terrestrial services without raising the multitude of problems associated with authorizing ancillary terrestrial components. *See* Telnor Comments at 7; Stratos Comments at 10-11; WCD Comments at 5-6; CTIA Comments at 12-13.

Globalstar, ACeS and Thuraya already provide users with combined MSS satellite and terrestrial services using dual-band phones. Motient, however, asserts without support that handset manufacturers would be reluctant to make dual-band phones for Motient's use. It is highly questionable why a manufacturer would be willing to design and produce a brand new handset for use with Motient's proposed terrestrial/MSS service, but not be willing to manufacture a dual-band phone, or possibly modify one of its existing dual-band products for the L-Band. Modifying existing dual-band phones for L-Band use would require primarily software changes to existing product lines, while creating a new dual-mode L-Band phone would also require engineering changes. Moreover, Motient has not shown that its proposed dual-mode, single-band phones would have any material advantages over existing or future dual-band phones.

B. Interference And International Coordination Problems Outweigh The Business Inconvenience Of Dual-Mode Phones

Certain commenters assert that, in order to establish terrestrial services for their users using of dual-mode phones, MSS operators would need to enter into unwanted relationships with cellular carriers. The cooperation of MSS operators and terrestrial communications companies is natural[69] and the fact that they may need to enter into commercial agreements with each other is not a legitimate reason to dismiss dual-band phones as a viable alternative to terrestrial use of the L-Band.[70]

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69 The convergence in the telecommunications industry is exemplified by the fact that New ICO's controlling shareholder also controls a national terrestrial CMRS provider, Nextel Communications, Inc.

70 *See* Comments of Mobile Communications Holdings, Inc. at 3-4, IB Docket No. 01-185, ET Docket No. 95-18 (filed Oct. 22, 2001).

Moreover, maintaining L-Band solely for satellite use does not mean that Motient would be required to contract with a third-party cellular provider in order to offer terrestrial services. Motient may be able to offer terrestrial service through its existing terrestrial network or, as Motient did when it acquired that business, Motient may be able to merge with another company that is licensed to provide PCS, cellular or other terrestrial services.

Motient essentially pleads with the Commission to allow it to provide both MSS satellite services and terrestrial-based services using the L-Band,[71] so that Motient can stay viable as a business. But that is not the Commission's responsibility. The Commission should be concerned with developing rules and policies that advance its policy goals, including enhancing competition.[72] Thanks to the Commission's recent market access decision, Inmarsat is now able to offer a competitive MSS alternative in the United States. The Commission previously has rejected the suggestions that protecting Motient's own economic interests is a legitimate regulatory goal, and it should decline to do so here as well.[73]

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71 Motient has asserted that Inmarsat has succeeded due to its "many years of operation as a monopoly intergovernmental organization, during which it absorbed substantial losses." Motient Comments at note 19. Contrary to Motient's allegations, Inmarsat was profitable by 1985, within three years after its founding. Inmarsat has since been privatized, no longer has any privileges or immunities of an intergovernmental organization, and it continues to remain profitable. Motient, with effectively exclusive rights to provide L-Band MSS service in the United States for five years, has simply not been able to develop its satellite network into a successful venture.

72 Chairman Powell has indicated on a number of occasions the need for letting the market determine the success of companies, stating, for example that "[w]e should not dare to pick technology winners or losers, whether consciously or unconsciously." (Commissioner Michael K. Powel, "Technology and Regulatory Thinking: Albert Einstein's Warning," speech before the Legg Mason investor Workshop, March 13, 1998).

73 *See Satcom Systems, Inc. and TMI Communications and Co.*, 14 FCC Rcd 20798 at ¶ 30 (1999) ("*TMI Order*"), *aff'd, AMSC Subsidiary Corporation v.* FCC, 216 F.3d 1154 (D.C. Cir. 2000).

VI. CONCLUSION

For the reasons discussed above and in Inmarsat's Comments, authorizing terrestrial uses in the L-Band would (i) create unacceptable inference to Inmarsat's satellite network, including vital safety services provided in the L-Band; (ii) violate the United States' obligations under the ITU Radio Regulations and under a separate international coordination agreement that governs use of the L-Band over North America, to which the United States is a party; and (iii) exacerbate existing spectrum scarcity problems in the L-Band. For these reasons, flexible terrestrial uses cannot be authorized under Section 303(y) of the Communications Act.

The solutions proposed by Motient and other commenters with regard to controlling interference from proposed terrestrial L-Band transmitters are neither technically sufficient nor practically implementable. Alternative methods of integrating L-Band MSS satellite service and terrestrial services, such as dual-band handsets, however, provide a means of enhancing the offerings of MSS service providers without creating the significant problems presented by Motient's proposal. Inmarsat therefore urges the Commission to maintain the L-Band strictly for satellite services.

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November 13, 2001

Supplemental Technical Annex

Executive Summary

In this Supplemental Technical Annex we address five separate technical matters where Inmarsat disagrees with Motient's technical analysis of potential interference from its proposed terrestrial mobile system. These matters have arisen either in response to the Comments recently submitted to the Commission in this proceeding, or as a result of new technical information that has recently come to light.

Firstly, in Section 1, we address the serious concerns of Inmarsat concerning Motient's proposals to measure the uplink interference levels using Motient's own satellite in order to predict the levels of interference that Inmarsat will receive at its satellites. In essence, Inmarsat believes this measurement proposal is technically flawed and, at best, would produce results that are prone to serious error in a such a way that Inmarsat could suffer harmful interference that is undetected by Motient.

Secondly, we provide measured evidence in Section 2 that there could be extended periods of time when there would be essentially no shielding of the Inmarsat satellite from the interfering transmissions of the proposed Motient terrestrial mobile transmitters when those transmitters are operating in a suburban environment. Inmarsat has from the outset been leery of the prior assertions of Motient that the Motient terrestrial mobile systems would be limited to operation only in urban environments. Inmarsat believed that such terrestrial systems, if authorized, would naturally extend their geographic reach to include at least suburban areas, and Motient, in its latest Comments in this proceeding, essentially admits that this is the case. Therefore, the value of the shielding factor for suburban environments is crucially important, and the data presented here by Inmarsat clearly shows there to be a problem as the shielding factor will be extremely low.

In Section 3 we provide new insight into the propagation models that Motient has been using thus far in this proceeding. The Hess model is not appropriate to calculate the average shielding factor, and it was never intended by Hess to be used for such a purpose. An alternative set of measurement data and propagation models is provided by Inmarsat and used to demonstrate an average shielding factor for an urban environment of 1.9 dB, compared to Motient's asserted value of 22.4 dB. The ramification of this is of course that only a very small number of Motient mobile transmitters would be needed to produce harmful uplink interference into Inmarsat, and therefore the Motient proposal for a terrestrial mobile system is not viable.

In Section 4 we note that any plans for terrestrial mobile operations in the "Big-LEO" frequency band (1610-1626.5 MHz) need to be considered very carefully in terms of the out-of-band emissions causing harmful interference into the MSS uplink band above 1626.5 MHz.

Finally, in Section 5, we examine in more detail the Motient claim that it is only proposing to use spectrum for its terrestrial system that is not being used by its satellite system. As a result we demonstrate that <u>any</u> spectrum used by Motient for its proposed terrestrial system would directly take away spectrum from Motient's satellite system, and thereby lead to Motient making greater demands for spectrum at the multilateral Region 2 L-band coordination meetings. Such demands would be in violation of the existing multilateral coordination agreement governing the way that the limited L-band MSS spectrum is divided among the various L-band MSS systems.

1 Motient Could Not Measure In-Orbit the Interference Levels that Inmarsat Would Suffer

For the first time in this proceeding Motient has admitted, in its Comments to this NPRM, that it would be necessary for Motient to take precautions to ensure that there is no harmful uplink interference caused to Inmarsat (and other MSS operators) by the Motient terrestrial mobile transmitters.[1] Prior to this, Motient had asserted that the interference levels to Inmarsat would be negligible, even with larger numbers of Motient terrestrial mobile transmitters in operation than Motient ever plans to use.[2]

The method proposed by Motient to monitor, and thereby control, the uplink interference level to Inmarsat simply will not work. Motient proposes to somehow measure the aggregate effective uplink EIRP from the entire territory of the USA in the direction of the Motient satellite and thereby infer from that data the actual interference level that Inmarsat would suffer. Motient is not specific about how this measurement will be made, but makes generalized conclusions that its system is bound to be sensitive enough to make this measurement because the Motient satellite antenna discrimination is less than the Inmarsat antenna discrimination. The critical details of how Motient will perform this measurement are absent from Motient's filings. Inmarsat believes that this detail is lacking because these measurements will be neither feasible nor accurate, for the reasons explained in the following subsections.

1.1 The aggregate uplink signal received by Motient's satellite is not necessarily the same as that received by Inmarsat's satellite

Motient argues that the aggregate signal power from the Motient terrestrial mobile transmitters received by its satellite at 101°W will always be greater than or equal to the aggregate signal power from those transmitters received at Inmarsat's satellite locations, such as 54°W. One of the assumptions underlying this theory, as explained by Motient, is that the signal blockage to the lower elevation satellite (54°W) will always be higher than it will be to the higher elevation satellite (101°W).[3] In this sub-section we address the difference in geometry between the Motient and the Inmarsat satellites, in terms of the signal path from the Motient mobile transmitters, and why Motient's assumptions about equivalent signal blockage cannot be relied upon to provide interference protection for the Inmarsat satellite network.

Firstly we note that the Motient terrestrial system is no longer limited to being deployed in urban environments according to Motient's latest Comments. Motient now states that it proposes to deploy its terrestrial system in suburban and even "sparse suburban" areas.[4] In these

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1 Motient Comments, Technical Appendix, pp. 3, 5-7.

2 This assertion has been strongly disputed by Inmarsat. Inmarsat has shown that a very small number of Motient mobile transmitters could cause harmful interference into the Inmarsat satellite network.

3 Motient Comments, Technical Appendix, p. 6.

4 Motient Comments, Technical Appendix, p. 4.

environments there is likely to be negligible signal blockage towards the Inmarsat satellite (i.e., with an elevation of 20° to 40°), and in many situations the signal blockage to the lower elevation Inmarsat satellite will be less than it will be to the higher elevation Motient satellite.

Secondly, there is a considerable difference in the azimuth pointing directions towards the Motient satellite at 101°W and an Inmarsat satellite such as the one operating at 54°W, for users located in the USA. Table 1-1 below provides the elevation and azimuth data for six example cities across the USA. Note that the azimuth difference ranges from almost 57° in the case of Denver to more than 90° in the case of Miami. This means that there often will be no correlation between the blockage in the two different signal paths to the two satellites.

Table 1-1. Azimuth and Elevation Pointing Directions for Six US Cities to the Motient and Inmarsat Satellites

Location	Motient Satellite at 101°W		Inmarsat satellite at 54°W	
	Azimuth (° clockwise from North)	Elevation (° above horizon)	Azimuth (° clockwise from North)	Elevation (° above horizon)
New York	218.7	35.5	151.2	39.1
Houston	191.7	55.0	119.4	33.7
Denver	174.3	44.2	117.5	21.3
Miami	221.6	52.2	131.3	48.4
Chicago	200.1	40.1	135.1	31.3
Atlanta	208.7	47.1	133.5	39.4

Based on these observations we show in Figure 1-1 below three example scenarios that are applicable to a typical suburban area, and which illustrate that the signal path to the lower elevation satellite is not likely to be blocked as much as the signal path to the higher elevation satellite. These are described below:

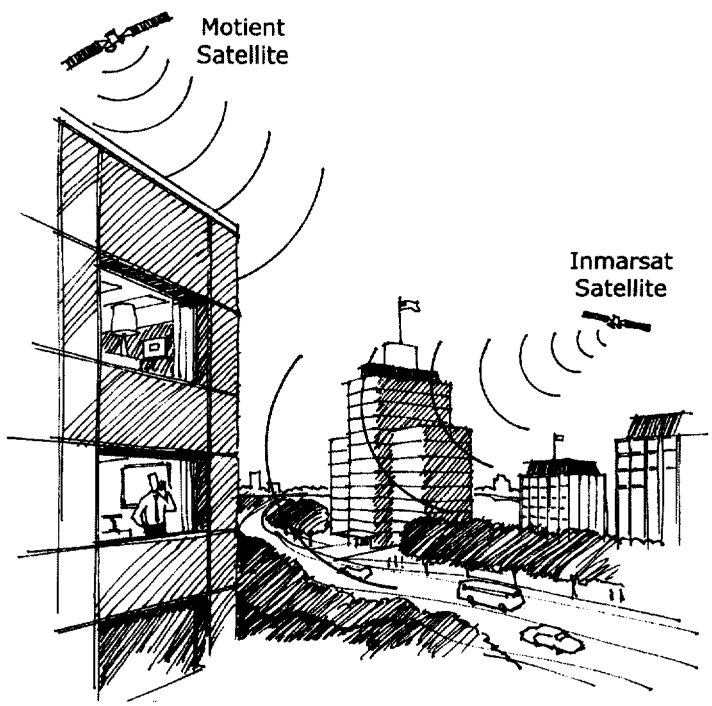
- The first shows a Motient mobile subscriber standing beside the window in an office building in which the blockage of the high elevation signal to the Motient satellite is a result of the several stories (concrete floors and ceilings) of the office building above the subscriber, whereas there is relatively small signal blockage through the window of the building towards the lower elevation Inmarsat satellite.

- The second example shows a Motient mobile subscriber walking along a sidewalk outside of a strip mall in a suburban area, and again the high elevation signal to the Motient satellite is blocked by the building and roof over the sidewalk, whereas the lower elevation signal to the Inmarsat satellite is a clear line-of-sight.

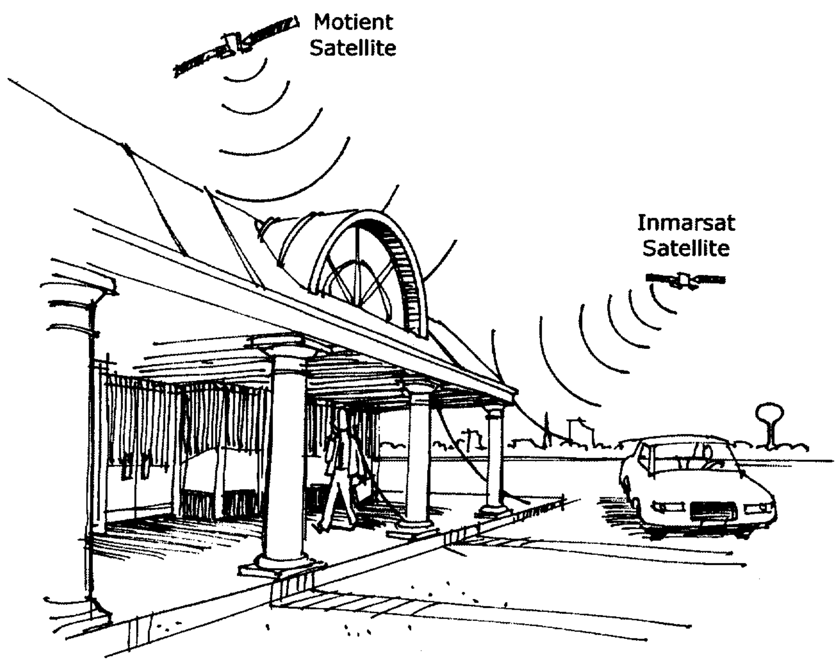
- The third example shows a Motient mobile subscriber using his telephone while inside a vehicle. The roof of the vehicle blocks the signal towards the Motient satellite but the signal to the Inmarsat satellite passes through the window of the vehicle with less signal attenuation.

Figure 1-1. Example Scenarios where the Signal Blockage is Less to the Inmarsat Satellite than to the Motient Satellite

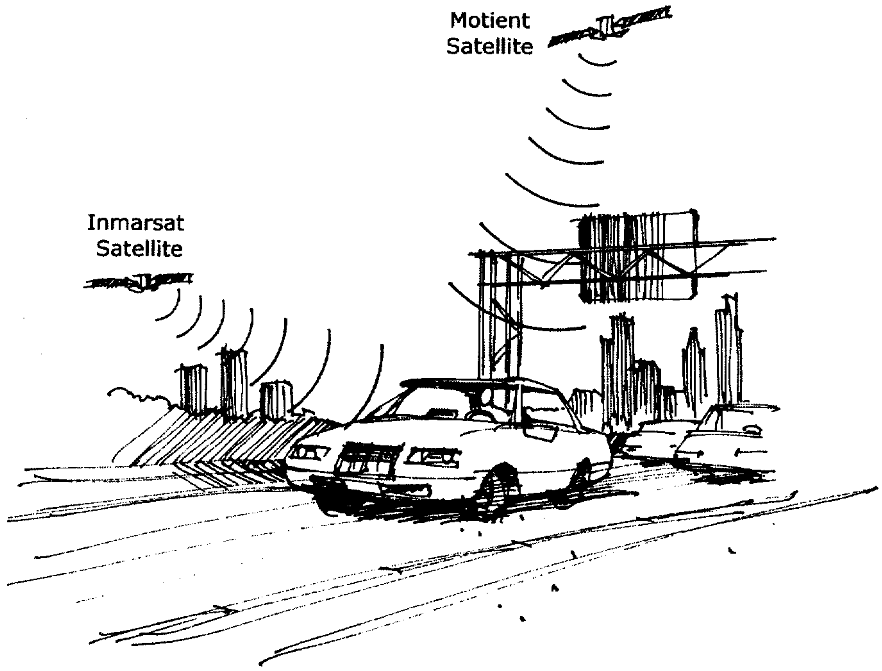
(a) Motient subscriber in office building



(b) Motient subscriber walking outside strip mall



(c) Motient subscriber in automobile



Therefore Inmarsat believes that any possible measurement that Motient could make at its own satellite would not reliably predict the interfering signal power received at the Inmarsat (or other MSS) satellite in a different part of the geostationary orbit. Such potential discrepancies are particularly problematic because only a small number of Motient mobile transmitters are needed to generate harmful interference to Inmarsat. Thus, statistical averaging of the interfering signals cannot be relied upon.

1.2 Motient's measurement would not include all the interfering contributions from across the USA that fall in the sidelobes of the Inmarsat satellite receive antenna

Motient claims that it will measure the uplink interference from its terrestrial mobile transmitters using an antenna discrimination of only –10 dB. Referring to Figure 5-1 below, which shows the –10 dB relative gain contour of a typical Motient spot beam, we can see that this gain contour exists quite close to the main beam, and this implies that such measurements based on an assumption of only –10 dB discrimination would only be accurate for a limited area surrounding the Motient receive beam. At further distances away from the Motient main beam, the Motient antenna discrimination will inevitably fall to a lower value of typically –20 dB or less. The result of this is that Motient's measurement, based on the –10 dB gain discrimination assumption, will only apply to a limited geographic area surrounding the Motient beam, and Motient's measurement system will be relatively insensitive to uplink interference originating from other geographic areas further away from the Motient beam.

To accurately measure the interference to Inmarsat, interfering signals into the Inmarsat satellite antenna sidelobes that arise from the entire geographic area of the USA would have to be measured. Therefore Motient's measurement of the interfering uplink signals originating from the area immediately surrounding one of its spot beams would severely underestimate the total interference that Inmarsat would suffer. It would therefore be necessary for Motient to aggregate the interference in some way from many of its spot beams in order to begin to assess the interference into Inmarsat, and even then it is unlikely that such a measurement would be accurate or even feasible. The measurements from each beam would include overlapping territory between the beams, and so a simple addition of the interference from each beam would not give the correct aggregate levels of interference.

Another way to consider this problem is that the satellite antennas of Motient and Inmarsat, at the frequencies where uplink interference will occur from the USA, are very different. Motient's antenna consists of a large number of spot beams covering the CONUS land mass whereas Inmarsat's antenna "sees" CONUS through its sidelobes. It would be virtually impossible to "calibrate" Motient's measurement of interference in a way to make it truly representative of the actual interference that Inmarsat would suffer.

Even if a technical means were found for Motient to accurately measure the uplink interference to Inmarsat, which we seriously doubt, there is still a fundamental problem here with a competitor of Inmarsat being in a situation where it directly controls the levels of interference into Inmarsat through means that are not transparent to Inmarsat or to the FCC.

Inmarsat therefore has serious concerns about the ability of Motient to accurately measure and control the aggregate uplink interference from its terrestrial transmitters from across the entire USA into the Inmarsat satellite network.

1.3 Motient cannot measure the interfering signal level reliably in the presence of its own signals

Motient has not indicated how it actually would measure the uplink interference from its terrestrial mobile transmitters. No specifics about this proposed measurement are provided by Motient although it repeatedly asserts that it will be able to monitor interference.[5] There appears to be no plan by Motient to include special monitoring receivers in the Motient satellite. Motient instead appears to rely upon the existing satellite receivers, and to measure the interference in the presence of its own intended satellite uplinks. The accuracy of such a measurement would be very poor because the intended signal component would dominate the measurement of the interference at the signal-to-interference levels necessary to ensure adequate protection of the Inmarsat uplinks. Thus, the interference protection measures proposed by Motient would be ineffective.

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[5] Motient Comments, Technical Appendix, pp. 5-7.

2 Measured Data Clearly Demonstrates the Negligible Shielding in Suburban Environments

In the Inmarsat Comments to this NPRM, it was suggested that an appropriate average shielding factor to use in the calculation of uplink interference from multiple simultaneously transmitting Motient terrestrial mobile transmitters is 3 dB.[6] We believe this could be an appropriate value for multiple simultaneous transmitters for some urban environments where a number of the interfering terrestrial mobile transmitters are operating inside buildings. However, based on the latest information from Motient in its Comments to the NPRM, it is clear that Motient no longer plans to restrict its terrestrial mobile system to urban environments. Motient now states that it proposes to deploy its terrestrial system in suburban and even "sparse suburban" areas.[7] In these environments there is likely to be negligible signal blockage towards the Inmarsat satellite, and use of a 3 dB shielding factor would understate the true interference potential of the proposed Motient terrestrial mobile transmitters.

An example measurement of the signal strength of the L-band signal from an Inmarsat satellite has been reported in an ITU-R publication for a mobile user in a suburban environment and this is repeated as Figure 2-1 below.[8] The measurement gives the fade depth (in dB) relative to clear-sky as a function of time. Although some short-term fades of over 18 dB can be seen, there are long periods of time where the fade is 0 dB. In fact, over a continuous 100 second period, the fade only briefly approached 4 dB. This clearly demonstrates that Inmarsat cannot be expected to rely, as an interference protection mechanism, on shielding of the Inmarsat satellite from the transmissions of a Motient mobile user terminal in a suburban environment. This measured evidence clearly contradicts the Motient assertion that an average shielding factor of 15 dB should be assumed in the assessment the interference potential of its proposed terrestrial system.

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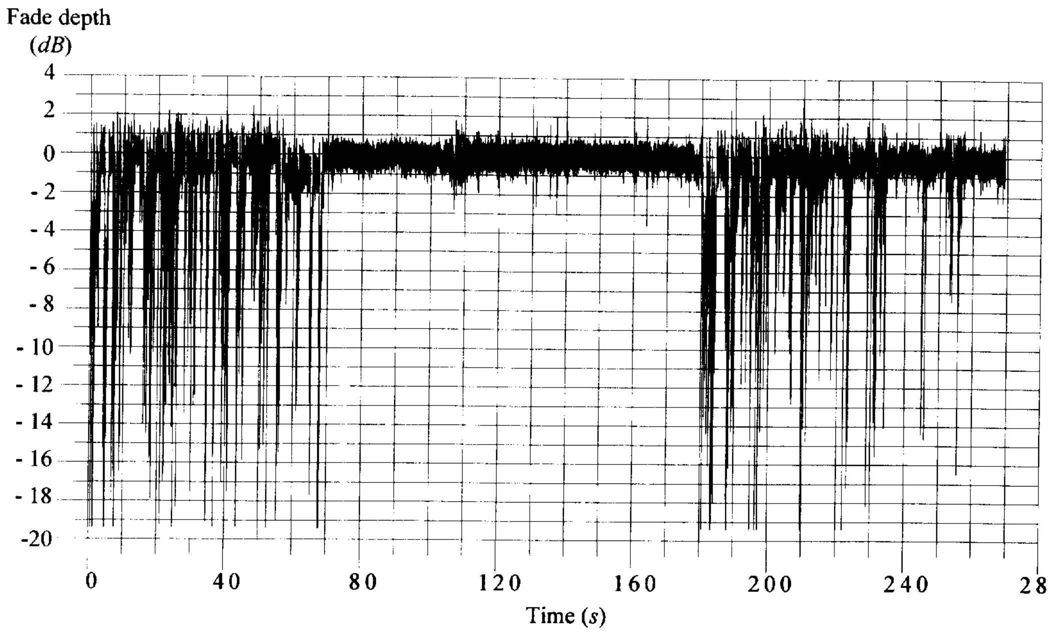
6 Inmarsat Comments, Section 4.1, pp. 24-26.

7 Motient Comments, Technical Appendix, p. 4.

8 ITU-R DSB Handbook, Annex B, Section B.10.2, pp. 402-403.

Figure 2-1. Measured satellite signal strength in a suburban environment



3 Motient's Use of the Hess Propagation Model is Inappropriate and Grossly Over-Estimates Potential Signal Blockage

Motient's assertions that the uplink interference, from the Motient mobile transmitters to Inmarsat's satellite receiver, should be acceptable relies heavily on Motient's assessment of the natural blockage that will occur on the signal path to the Inmarsat satellite. In this assessment Motient cites the Hess propagation model to support its claims that the blocking factor will average 22.4 dB in urban areas and 16.9 dB in suburban areas.[9] By contrast, Inmarsat believes this blocking factor (i.e., the average attenuation) is likely to be 3 dB or less, even in urban areas. This almost 20 dB discrepancy is very significant in the overall assessment of uplink interference.

3.1 Inadequacy of the Hess model for calculation of interference shielding

The Hess model is based upon the first propagation experiments that were targeted towards land mobile satellite communications which were conducted in 1980 by observing 860 MHz and 1550 MHz transmissions emanating from NASA's ATS-6 spacecraft.[10] The Hess model is based on statistical manipulation of data aimed at defining "small-scale" and "large-scale" probabilities

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9 Motient Comments, Technical Appendix, pp. 1, 4.

10 Hess, G.C., "Land-Mobile Satellite Excess Path Loss Measurements", IEEE Transactions on Vehicular Tech., Volume VT-29, No. 2.

of the path attenuation data.[11] The whole purpose of the Hess model is to aid in quantifying the propagation conditions that will affect the link availability for MSS users, where the attenuation along the signal path degrades the signal level and performance of an MSS link for a single user at a time. The model predicts the percentage of time that the path attenuation will be less than a certain value (e.g., less than 25 dB of path attenuation for 90% of the time). These probabilities range from 50% to 99% with the latter value giving the highest fade attenuation value. The Hess model *does not* predict the level of fades occurring at percentages smaller than 50%, which corresponds to the weaker fades. The Hess model does not provide this data because it is designed to deal with path attenuation as a problem to be surmounted, not as a device that is to be relied upon as a primary means of preventing unacceptable interference into another system.

By contrast, in order to assess the appropriate blocking factor for purpose of calculating the uplink interference from the Motient mobile transmitters into the Inmarsat satellite receiver we need to assess the *aggregate* interference from a number of mobile transmitters by predicting the path attenuation averaged across all those transmitters. This requires knowledge of the path attenuation and associated probability for all percentages smaller than 50% - a range that Hess's model does not predict. Determining the percentages of time that little or no attenuation is expected is critical when one is relying on attenuation to prevent interference. For example, it is not enough to know that attenuation will be less that 9.5 dB for 90% of the time in a semi-urban environment. One also needs to know how often the attenuation will be 0, 1, or 2 dB, and any other value below 9.5 dB. To perform the necessary calculations, we therefore cannot use the Hess model.

3.2 Motient's incorrect understanding of the average shielding factor

Relying on data from the Hess model, Motient attempts to calculate the uplink interference to Inmarsat asserting an "average" shielding factor of 22.4 dB (for urban areas) for all the Motient mobile transmitters.[12] There are two flaws with this assumption. First, as noted below, the Hess

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11 Hess obtained the small-scale probabilities by accumulating many short-term fade files derived from approximately 100 m driving intervals. Assuming a speed in an urban community of 10 m/s ($\approx$22 miles/hour), each small-scale file represents approximately 10 seconds of data or the time of a mobile user to make a short comment. A cumulative fade distribution was constructed for each short-scale file (say file i) and a "success" percentage (e.g., 90%) was defined and related to the corresponding fade being smaller than, say A_{qi} for the ith file. Other cumulative distributions were constructed comprising all values of i (ith short-scale file) and the corresponding values of A_{qi} were noted. The "large-scale" probability" was derived by taking the cumulative fade distribution of the values of A_{qi} at a specific percentage level. This new probability (large-scale) thus represents the probability of being smaller than individual fade levels belonging to successful phone comments (e.g., defined by the 90% level) over a large area of coverage. The physical significance that may be attributed to the large-scale probability is that it predicts the probability that the fade will be less than a particular fade level over many kilometers of driving, assuming a given small-scale probability which denotes the likelihood of successful reception (e.g., 90% of the time) over an approximate 100 m driving distance.

12 Motient Ex-Parte Presentation, July 6, 2001 (filed July 6, 2001), pp. 5-6.

model simply does not provide data about "average" attenuation - the 50% probability value in the Hess model is a *median* attenuation figure. Median data represent different quantities than average data. Second, use of the 22.4 dB value is misleading. Although impossible to verify from the information supplied by Motient, this value of 22.4 dB would appear to be the attenuation derived from the Hess model using a value of approximately 90% for both the large-scale and small-scale probabilities, for an urban environment. Why Motient chose probability data corresponding to 90% is not clear – presumably in order to derive as high an attenuation value as possible. Use of this value is misleading because this value tells you that there is a 90% chance that actual attenuation will be less that 22.4 dB, without indicating the chance that actual attenuation will be so low, such as 0 dB or 1 dB, that it will be insignificant as a means of shielding. It is interesting to note that if both the small-scale and large-scale probabilities are reduced to 50% with all other parameters constant, under the Hess model, the attenuation figure drops from 22.4 dB to 7 dB for the urban environment (i.e., there is a 50% chance attenuation will be less that 7 dB).

Even use of the 50% probability data from the Hess model is incorrect for ascertaining the ability of Motient to protect the Inmarsat system. The 50% probability value simply means that half the time the fade is higher than a certain value and half the time it is lower than this value. It is <u>not</u> the average attenuation value that can be applied to all the interfering mobile transmitters. It takes no account of the operation of interfering mobile transmitters in situations where the path attenuation is significantly less than the 50% value.

Inmarsat believes that the only way to correctly calculate the aggregate interference from all the transmitting Motient mobile terminals is to use a propagation model that provides attenuation data for the full range of probabilities from essentially 0% to 100% of the time. Data from the Hess model, which only predicts attenuation at probability levels of 50% and greater, is just not suitable for this. An alternative propagation model that is appropriate for this calculation is discussed in the following sub-section.

3.3 Inmarsat's calculation of the average shielding factor

In this sub-section we will present a rigorous way of calculating the aggregate uplink interference from the Motient mobile transmitters. This is based on satellite measurements performed in Tokyo (urban environment) at 1.5 GHz by Karasawa et al. [13] and the three-state fade model described by Goldhirsh and Vogel [14]. Figure 3-1 below provides the typical results for the Tokyo urban environment. The left set of curves denotes measured and modeled fade

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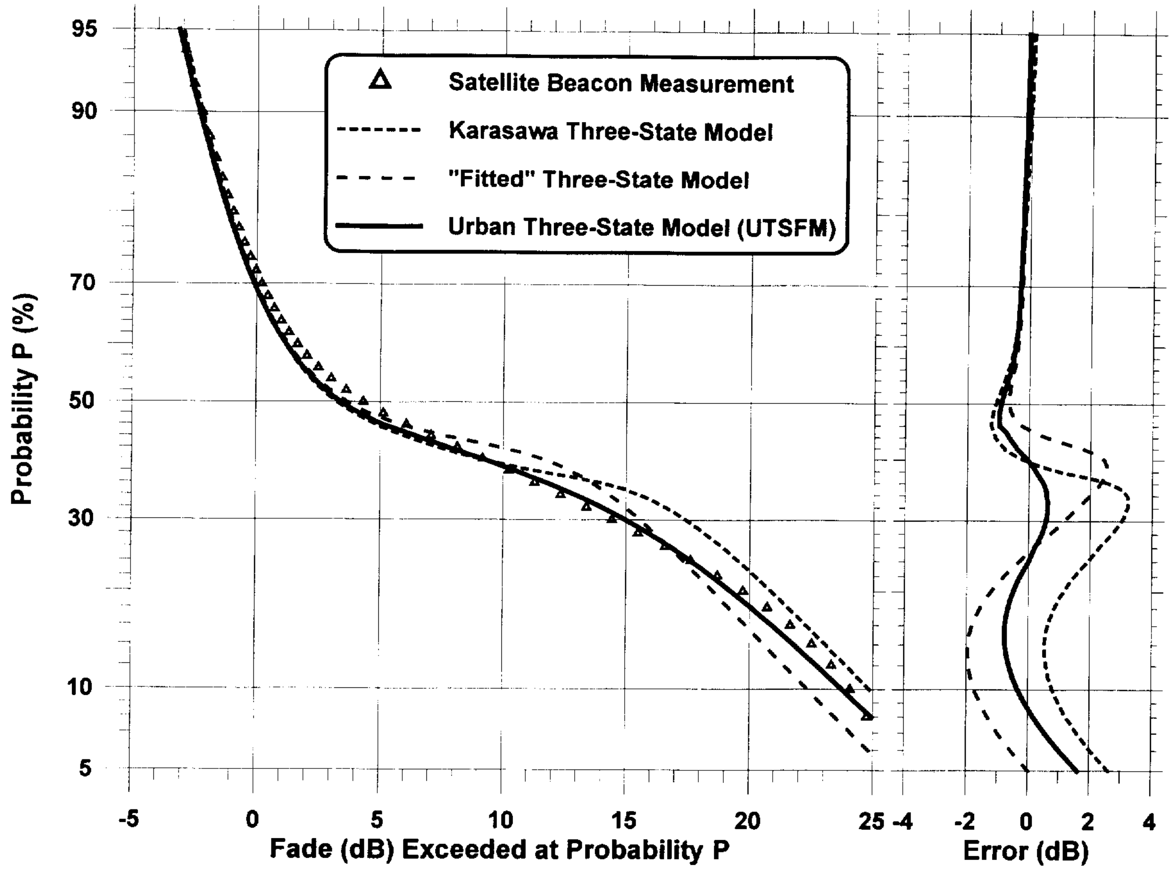
13 Karasawa, Y., K. Minamisono, and T. Matsudo [1995], "A propagation channel model for personal mobile-satellite services," Proceedings of Progress of Electromagnetic Research Symposium of the European Space Agency (ESA), Noordwijk, The Netherlands, July, pp. 11-15.

14 Goldhirsh, J. and W. J. Vogel [1998], Handbook of Propagation Effects for Vehicular and Personal Mobile Satellite Systems," APL JHU Technical Report A2A-98-U-0-021 and EERL/UOT Technical Report EERL-98-12A, December.

distributions at 32° elevation and at a frequency of 1.5 GHz.[15] The right-hand curves represent the fade differences between the measured and modeled distributions at different percentages.

15 It should be noted that Inmarsat's Atlantic Ocean Region-West satellite, which is located at 54°W longitude, provides an elevation angle of 30° or greater for all of the CONUS east of a line stretching from Chicago to a point between San Antonio and El Paso. Therefore the propagation data in Figure 3-1, which is for an elevation angle of 32°, is quite appropriate for assessing the interference to Inmarsat.

Figure 3-1. Measurement Data and Propagation Model Results as a Cumulative Distribution Function

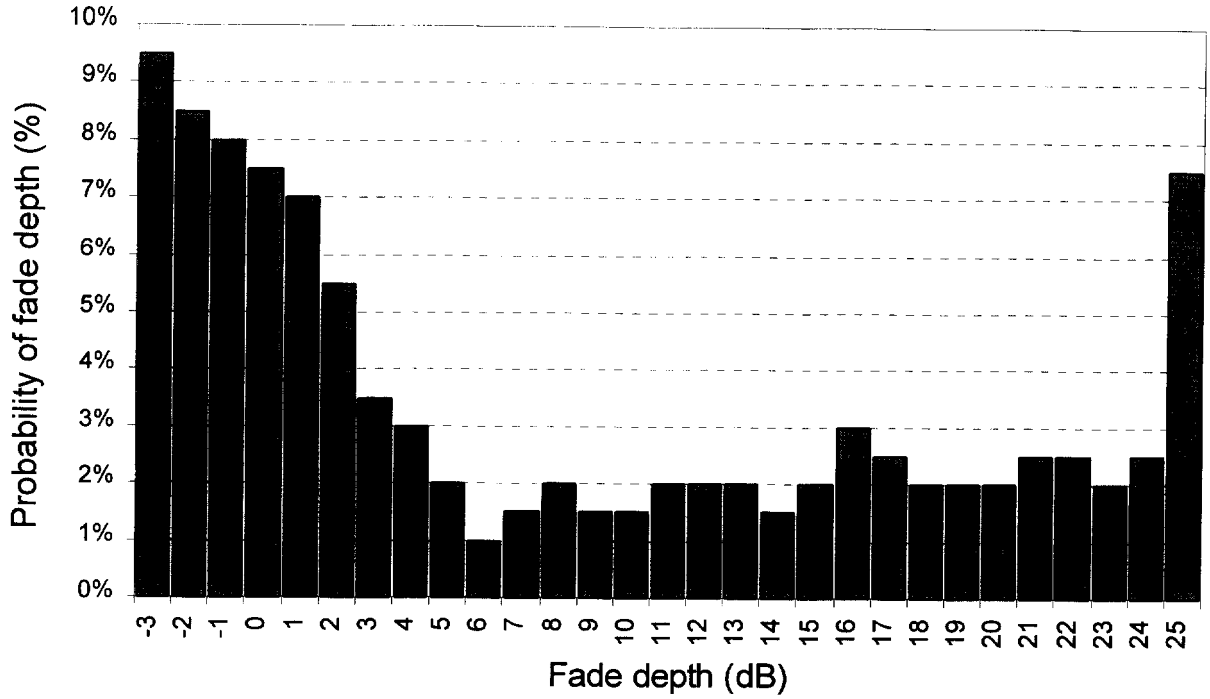


The probabilities along the vertical scale conforms with the ITU-R accepted convention of representing the "Probability of exceeding the abscissa value" as opposed to Hess's convention which gives the "Probability that the fades are smaller than the abscissa values." The important point about the data given in Figure 3-1 is that it fully defines the path attenuation up to 95% probability (equating to 5% probability under the convention used by Hess), which is far more complete than the data provided by the Hess model, for the reasons provided in Section 3.1 above. Thus, the data in Figure 3-1 allows us to fully analyze the chances that the predicted fade will not be effective in shielding the Inmarsat network from the interfering Motient signals.

An interesting point to note from Figure 3-1 is that it predicts that the fade depth will exceed 0 dB for 70% of the time, i.e. for 30% of the time the path attenuation is actually negative and there is a net propagation path power *enhancement* relative to the clear sky condition, which is a result of the multi-path from building reflections in the urban environment.

The data in Figure 3-1 is a *cumulative distribution function.* From this we have calculated the *probability density function* which simply gives the probability of the attenuation being within a set of attenuation sub-ranges or "bins", and this is given in Figure 3-2. Each bin is shown as a bar in the graph. The –1 dB bin, for example, refers to a range of attenuation levels from –1.5 dB to –0.5 dB, so each bin covers an attenuation range of 1 dB. The only exceptions are the bins at the extremes of the attenuation range which additionally include all attenuation levels outside the bounds of the distribution given in Figure 3-1.

Figure 3-2. Measurement Data and Propagation Model Results as a Probability Distribution Function



The next step in calculating the average attenuation for a number of Motient mobile transmitters is to calculate the weighted attenuation for each bin, by multiplying the attenuation (converted to a linear value) by the probability associated with that bin. Adding up all these weighted bin attenuation values gives the average attenuation, which is then converted back to a dB value. The result is an average attenuation value of 1.9 dB for the data in Figures 3-1 and 3-2.

The average attenuation of 1.9 dB may be interpreted as representing the "average shielding" obtained when the fades encountered by the entire population of users are averaged over the coverage area. It is interesting to note that this average fade is close to the median value (50%) in Figure 3.1 which tells us that 50% of the users will experience shielding smaller than 3 dB. This average value of 1.9 dB is a far cry from the 22.4 dB value that Motient proposes we should use for this calculation.

Note that the data in Figures 3-1 and 3-2 are taken from measurements made in Tokyo, which is an urban environment with a large number of concentrated high-rise buildings. In many US cities the shielding due to the buildings is likely to be less than in Tokyo and so the average attenuation likely will be less than the 1.9 dB calculated above. Of course in suburban areas the average attenuation would be even less.

3.4 Significance of the street directions on the blocking factor

The data given in Figures 3-1 and 3-2 above assumes random positioning of the mobile subscribers in the streets of Tokyo. The heading directions of the streets are essentially also random - some may line up with the azimuth direction of the satellite and others will be at right angles to the azimuth direction, and of course others will be somewhere in between these two extremes. In the Hess analysis provided by Motient the heading direction of the street (parameter is called "HEAD") is assumed to be at 45° relative to the azimuth direction of the satellite.[16] Hence the effects of heading were averaged out. However, Hess himself observed that the signal attenuation is highly dependent on the street heading direction – here are the comments of Hess in his 1980 report of the measurements:[17]

> *"The importance of street heading became clear during the data collection phase so this parameter was quantized into 45° steps. For example, in cities like Denver and San Francisco with streets running NE/SW, little signal shadowing was apparent, despite the presence of large buildings on both sides of the street. This is because the satellite itself was located to the SW and thus a line-of-sight signal component could readily be maintained."*

To quantify the effect described by Hess we have calculated cumulative fade distributions from measured (not modeled) UHF distributions given in Hess's paper for the two extreme cases of (a) streets aligning with the satellite azimuth, and (b) streets that are orthogonal to the satellite azimuth. The results are shown in Figure 3-3 where we have used the convention showing the probability of exceeding abscissa fades. Note the huge difference between the two curves, which illustrates how sensitive the path attenuation is to the street alignment. For streets aligned with the satellite azimuth the path attenuation can be exceedingly low. For example, only 30% of the time does the fade exceed 4 dB when the streets are aligned with the satellite compared to approximately 24 dB when they are not.[18]

There are two important ramifications of this phenomenon, as follows:

1. As Inmarsat has demonstrated in its Comments to this proceeding, harmful interference to Inmarsat's uplink would occur with a relatively small number of Motient mobile transmitters using a shielding factor of 3 dB. If such a small number were found to be operating in streets aligned with the Inmarsat satellite azimuth there would be almost no shielding.

2. The method of calculating the average shielding factor, described in Section 3.3 above, shows how the overall average attenuation is heavily influenced by the mobile

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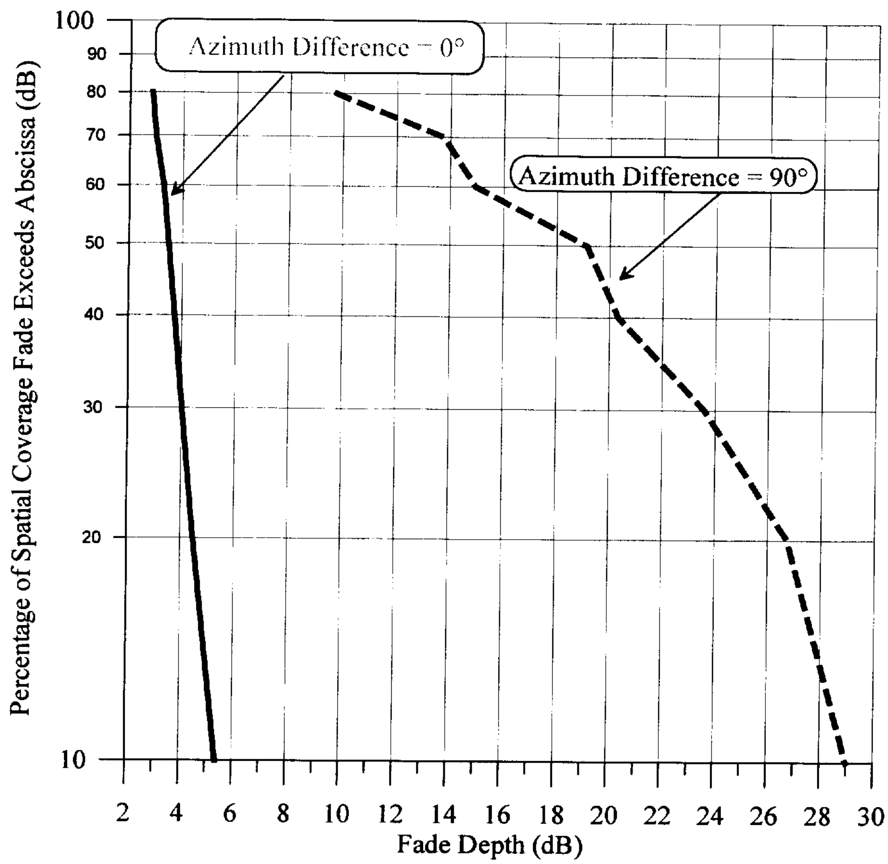
16 Motient Ex-Parte Presentation, July 6, 2001 (filed July 6, 2001), p. 5, footnote 7.

17 Hess, G.C., "Land-Mobile Satellite Excess Path Loss Measurements", IEEE Transactions on Vehicular Tech., Volume VT-29, No. 2.

18 It should be noted that, in his results, Hess showed experimental values outside the bounds of his model.

transmitters that are operating with relatively low signal attenuation. That averaging analysis could be extended to take into account the range of street heading directions, and would likely lead to even lower levels of average attenuation than that calculated in Section 3.3 above.

Figure 3-3. Comparison of Urban Fade Distributions at 860 MHz Measured by Hess [1980] in Denver for Streets whose Azimuths Approximately Align with the Satellite Azimuth (solid curve) and for Streets whose Azimuths are Approximately Orthogonal to the Satellite Azimuth (dashed curve).



4 Ancillary Terrestrial Systems in the 1610-1626.5 MHz Big-LEO Frequency Band Could Cause Uplink Interference to Inmarsat

Certain parties in this proceeding promote the use of an ancillary terrestrial component to MSS systems in the Big-LEO MSS frequency bands. This would involve potentially large numbers of terrestrial mobile transmitters operating in the 1610-1626.5 MHz band, which is immediately adjacent to the Inmarsat MSS uplink band (1626.5 MHz and above). The aggregate effect of the out-of-band emissions of these terrestrial mobile transmitters could, unless adequately controlled, cause harmful interference into the Inmarsat uplinks that are operating in the USA. This interference effect is identical to that described in the Technical Annex attached to Inmarsat's Comments in this proceeding, and the same interference results apply as presented there.[19]

5 Motient's Terrestrial System Will Directly Reduce the Spectrum Available for Use by the Motient Satellite System

In the Inmarsat Comments to the instant NPRM an analysis was provided that shows the severe uplink interference that Motient's satellite system would suffer from its own proposed terrestrial transmitters, if that terrestrial component is implemented.[20] That self-interference would inevitably lead to a loss of capacity in the MSS spectrum used by Motient. Based on additional information provided in Motient's Comments to this NPRM it is also now clear that Motient's proposed terrestrial system will use frequencies that otherwise could be used in the same or adjacent geographic area by the Motient satellite system, and thereby would directly reduce the spectrum available for use by the Motient satellite system. In each case, the end result would be that Motient would have to demand access to more L band spectrum than it really needs to provide just satellite services. This assertion is explained and justified in detail below.

The next generation Motient satellite design will use multiple spot beams which can be configured and combined in a variety of ways according to the Motient application.[21] Figure 5-1 below shows a subset of these Motient spot beams covering a portion of the USA. The exact size of the spot beams shown in Figure 5-1 is not crucial to the argument being developed here but every effort has been made to ensure that these spot beams are the same size as indicated by Motient in its FCC application.[22]

Various cell re-use patterns are possible with an array of spot beams as shown in Figure 5-1, ranging typically from a 4-cell pattern to a 7-cell pattern. Motient does not state in its application which it will use, but the conclusion below does not change whatever the re-use pattern is.

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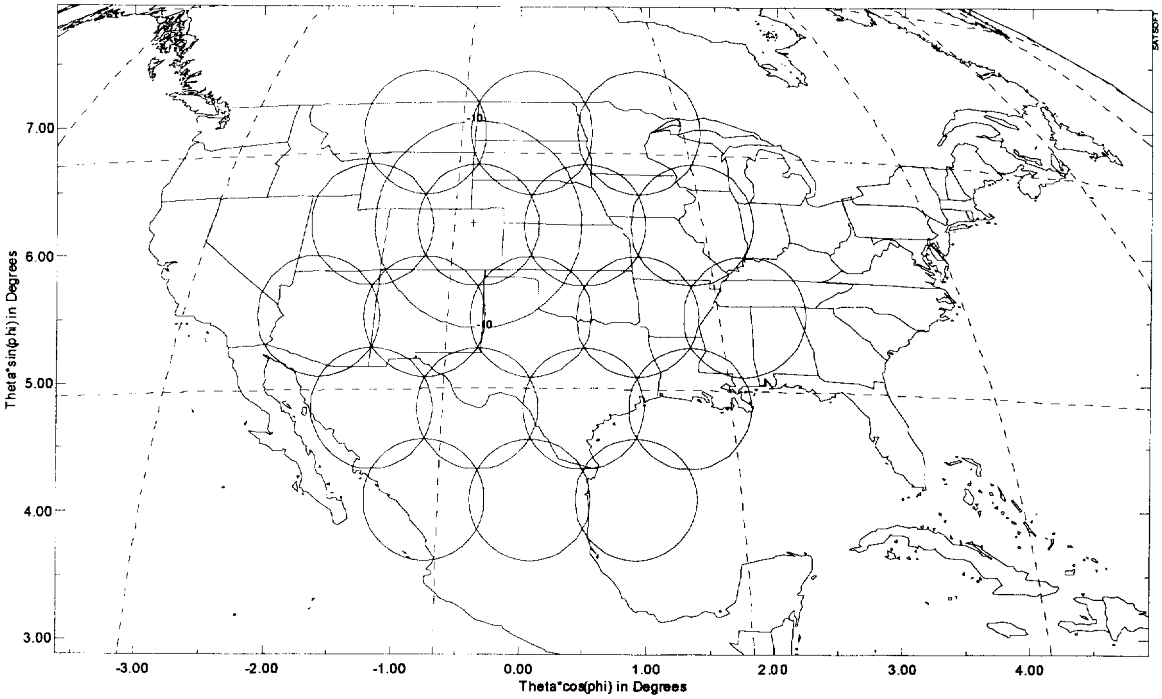
19 Inmarsat Comments, Technical Annex, Section 3.2, pp. 6-7.

20 Inmarsat Comments, Section 3.5, pp. 21-23.

21 *Mobile Satellite Ventures Subsidiary LLC Application for Assignment and Modification of Licenses and for Authority to Launch and Operate a Next-Generation Mobile Satellite System, et al.*, File No. SAT-ASG-20010302-00017, et al. (filed March 1, 2001) (the "*Application*"), Appendix A, Section 1.4, pp. 5-10.

22 *Mobile Satellite Ventures Subsidiary LLC Application for Assignment and Modification of Licenses and for Authority to Launch and Operate a Next-Generation Mobile Satellite System, et al.*, File No. SAT-ASG-20010302-00017, et al. (filed March 1, 2001) (the "*Application*"), Appendix A, p. 9, Figure 1-5.

Figure 5-1. Subset of Motient Spot Beams over USA



Consider the seven beams in the center of Figure 5-1. Between them they can use all of the satellite spectrum available with typically one quarter (for a 4-cell re-use pattern) or one seventh (for a 7-cell re-use pattern) of the available spectrum available in each beam. If we now superimpose Motient's proposed terrestrial system onto this beam pattern, let us consider which frequencies Motient could use for its terrestrial system in the center beam. Obviously Motient cannot use for its terrestrial system the spectrum used in the center beam by the Motient satellite system without taking that spectrum away from the satellite system. Furthermore, within the center beam, Motient cannot use for its terrestrial system any of the frequencies used by the Motient satellite system in the surrounding six beams without taking that spectrum away from satellite use in those beams, *because Motient's stated requirement for 10 dB isolation is not met.*[23,24] This is demonstrated by the 10 dB contour drawn in Figure 5-1 for one of the six beams surrounding the center beam. This contour significantly overlaps the center beam, preventing Motient from reusing the spectrum used for satellite service in that beam for terrestrial service in

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23 Motient Consolidated Opposition to Petitions to Deny and Reply to Comments, May 7, 2001, Technical Appendix, p.3. Also see Motient Comments, Technical Appendix, Section III, p. 6.

24 Inmarsat does not agree that reuse between Motient's satellite and terrestrial systems is possible with only 10 dB satellite antenna discrimination. In the Inmarsat Comments is was demonstrated that with 10 dB antenna discrimination very high levels of self-interference would be caused to the Motient satellite system. However, if we accept Motient's claim that they can reuse frequencies with only a 10 dB antenna discrimination, then reuse of the terrestrially used frequencies by the satellite system in the adjacent beam simply is not possible because the antenna discrimination in the adjacent beams is significantly less than 10 dB over a very large part of that beam. In some parts of the adjacent beam the antenna discrimination is even as low as 3 dB or less.

the center beam. The same constraint obviously applies to the other surrounding beams, and consequently none of the spectrum used by Motient's satellite service in the middle seven beams of Figure 5-1 can be used for terrestrial service without taking that spectrum away from the satellite service. Since *all* of Motient's satellite spectrum is used by these seven beams, the use of any spectrum by Motient's proposed terrestrial system in the geographic area of a satellite beam inevitably means that spectrum can no longer be used for the provision of MSS in either that satellite beam or any of the immediately adjacent satellite beams. The result is a reduction in the number of times spectrum can be re-used in the satellite system, and therefore a reduction in the overall spectral efficiency of the satellite system.

The above conclusion is consistent with Motient's explanation of how its "dynamic radio resource manager" will operate.[25] Motient explains that, when a "micro-cell" is implemented (which corresponds to a terrestrial cell or cells) this takes away spectrum from the "macro-cell" (which corresponds to the satellite beam), and that spectrum can no longer be used by that macro-cell (or satellite beam). The result of this is that Motient will not be able to carry as much satellite traffic in its coordinated spectrum if it implements its terrestrial system.

Therefore, any spectrum used terrestrially by Motient within a satellite beam area will inevitably reduce the spectrum available for Motient to use within that beam, or the immediately adjacent beams, by its satellite system. This will lead to Motient demanding more spectrum at the annual international coordination of L-band MSS spectrum in Region 2 than it would do with a satellite-only MSS system. For example, assume that Motient had successfully coordinated, based on actual satellite user requirements, 20 MHz of L-band spectrum at the multilateral Region 2 coordination meeting prior to any of its proposals to implement an ancillary terrestrial system. If it were to implement its proposed terrestrial system and use say 7 MHz of this 20 MHz in its terrestrial network within a high-traffic beam area such as the north-east corridor of CONUS, then only 14 MHz would be left available for the Motient satellite users in and around this area. Presumably there would still be a demand for 20 MHz of spectrum for the satellite users, and so Motient would be forced to go to the next multilateral coordination meeting and request a total of 27 MHz of L-band spectrum. This would be totally inappropriate and in violation of the multilateral agreements with other nations that have already been reached. If on the other hand Motient's MSS satellite operations does not require the whole 20 MHz of spectrum then the US is obligated, by the multilateral coordination agreement, to make the spectrum not required available to the other MSS operators that serve Region 2.

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[25] Motient Comments, Technical Appendix, pp. 3-4, including footnote 5.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in the foregoing submission, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this pleading, and that it is complete and accurate to the best of my knowledge and belief.

Richard Barnett

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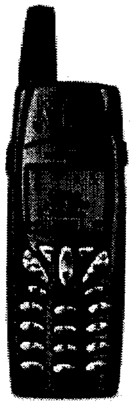
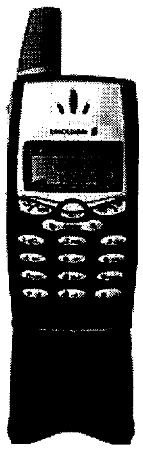
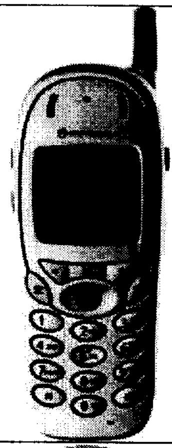
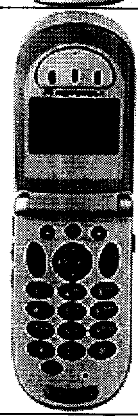
Dated: November 13, 2001

Exhibit A

	Make & Model: ERICSSON R520m Weight: 105 g Size: 130 x 50 x 16 mm Recommended Retail Price: ~$150
	Make & Model: ERICSSON T39m Weight: 86 g Size: 96 x 50 x 18 mm Recommended Retail Price: ~$270
	Make & Model: ERICSSON T68m Weight: 86 g Size: 100 x 48 x 20 mm Recommended Retail Price: ~$450

	Make & Model: MOTOROLA Ti280e Recommended Retail Price: ~$150
	Make & Model: MOTOROLA V66e Weight: 79 g Size: 84 x 44 x 21 mm Recommended Retail Price: ~$225
	Make & Model: MOTOROLA L7089 Weight: 108 g Size: 130 x 46 x 24.5 mm Recommended Retail Price: ~$150